

A Modified Alveolar Split Osteotomy and Bone Expansion Technique with Simultaneous Grafting and Implant Placement

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Received: December 26, 2016; **Published:** January 09, 2017

Abstract

Narrow alveolar ridges remain a clinical challenge for the successful endosseous implant placement. This article describes a modified ridge-split technique, together with spreading and lateral bony augmentation, and simultaneous implant placement in the posterior mandible. The presented case showed both clinical and radiographic success following implant placement and loading with a 3 years follow up.

Keywords: *Mandibular; Distal Extension; L-Shape Split*

Introduction

Lack of sufficient bone to place an implant at the functionally and aesthetically most appropriate position is a common problem. This happens as a result of long time since extraction of teeth. Treatment of atrophic ridge especially in posterior mandibular is accompanied with great problem in achieving successful results with endosseous implants [1].

This clinical report describes a technique for ridge splitting, and gradual expansion in the mandible with simultaneous implant placement within the split ridge. With the preservation of the thin buccal plate of bone for proper blood supply.

Clinical Case Presentation

A 44-year(s)-old female patient was presented to the clinic seeking implant-fixed prosthesis to replace lost lower right molars. Clinical and radiographic examination revealed a thin cortical crest and adequate cancellous bone to allow ridge splitting and expansion.

Full thickness mucoperiosteal flaps were reflected on the buccal and lingual aspects of cortical plates (Figure 1) Starting from a point 2 mm distal to the second premolar; a high speed thin diamond bur was used for the separation between both buccal and lingual plates of bone and extending posteriorly along the crest of the ridge for 16 - 18 mm. This was enough to accommodate two Straumann bone level implants with 4.1 mm diameter and a 3 mm space in between, and to avoid any crack or dehiscence. Depth of the drilling was 13 mm with a 3 mm more than the proposed implant length used (10 mm) to ensure full bony contact (Figure 2).

At the mesial end of the horizontal split done; a 2mm round bur was used for a round osteotomy hole made to act as a buffer "hinge" for the buccal and lingual plates of bone in the separation steps, and as the future implant bed (Figure 3).

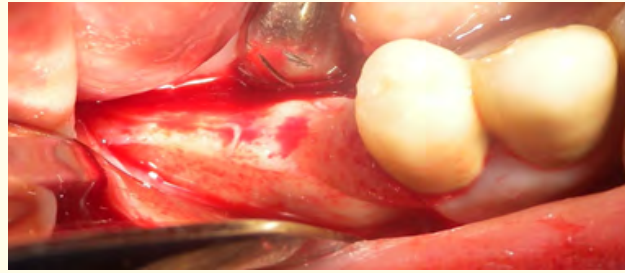


Figure 1: Full flap reflection showing the ridge after alveoplasty.



Figure 2: Horizontal crestal ridge splitting.

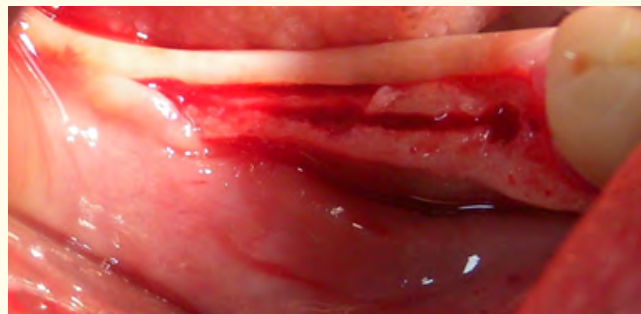


Figure 3: Round osteotomy at mesial end of the horizontal split.

At the distal end of the horizontal split: a vertical cut was made with the high-speed bur within the vicinity of the buccal plate of bone; for the start of the separation. With a full depth of 13 mm corresponding and joining the previous vertical cut.

Final design of the splitting cut was (L-SHAPE) SPLIT, with only one distal vertical cut and a mesial osteotomy round hole, for preservation of both the integrity of buccal plate of bone and the blood supply from intact cancellous bone at the depth of the split area, and decreasing the risk of buccal plate separation (Figure 4).

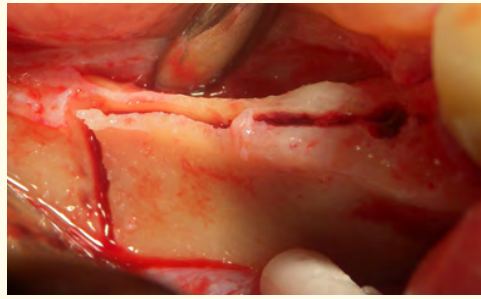


Figure 4: Final design of the splitting cut.

Separation between the buccal and lingual plates of bone was carried out slowly and with caution to avoid any crack or complete separation of the cortical plate, using successive sizes of chisels, starting from the distal end towards the mesial round osteotomy hole and going down from the crest apically. At the end of the hand maneuver; the two plates were separated giving a space reaching to double the size of the original bone available. This was gained thanks to the resiliency and wide cancellous bed of bone, and a mesial round osteotomy bed (Figure 5).

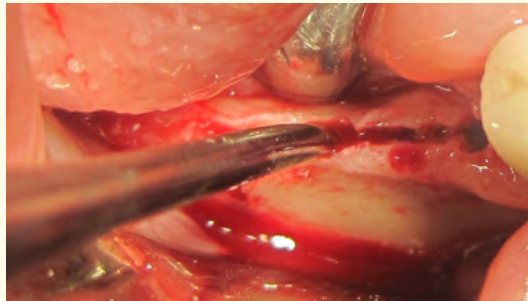


Figure 5: Start of the separation between the buccal and lingual plates of bone.

A sequence of spreaders was used for the preparation of the mesial implant bed. Going within the first hinge round bur prepared for the force buffer, 2 mm away from the natural tooth making use of the cancellous bone distal to the premolar (Figure 6).

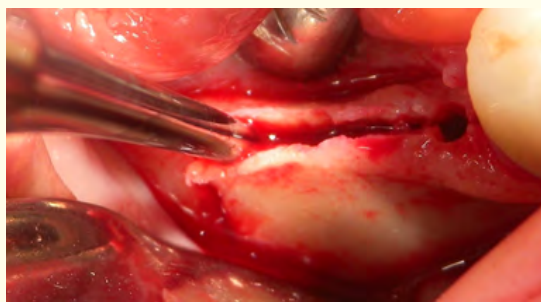


Figure 6: With the successive sizes and slow movement; the buccal plate of bone started to be separated and was moved away from the lingual plate.

A periapical radiograph was recorded to check the parallelism between the first spreader and the premolar. And then the length of the proposed implant (10 mm) was reached. The successive sizes of the spreading kit were used to finalize the preparation of the implant bed (Figure 7).

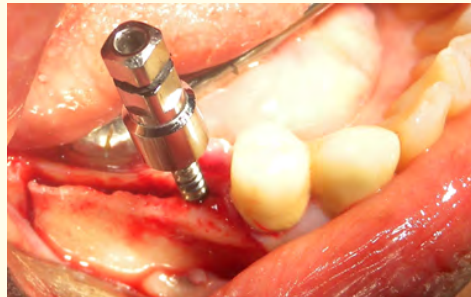


Figure 7: Preparation of the implant bed in the mesial end of the horizontal split using the spreading kit.

With the final size of the spreading kit in place in the first implant osteotomy bed; the first size of the spreaders was placed in the proposed second implant osteotomy site with a 3 mm distance (Figure 8).

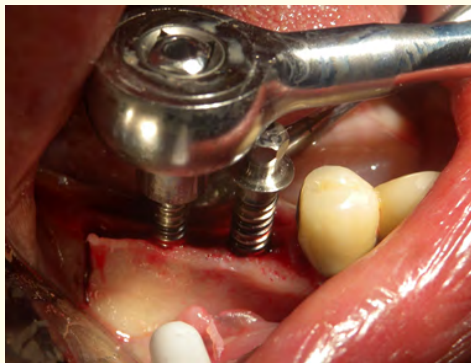


Figure 8: The final size spreader in the first implant osteotomy site with the first spreader in the second implant bed 3 mm apart.

With the continuous spreading of the second implant bed; the prepared first implant osteotomy site was wide enough to receive the first implant; hinging into three walls to the length of 10 mm, and leaving a 3 mm buffer of the apical cancellous bone in order to control the forces of separation between the buccal and the lingual plates, and protect the buccal plate of bone from fracture. At the end; this also caused more separation between the buccal and lingual plates; for the second implant seating (Figure 9).

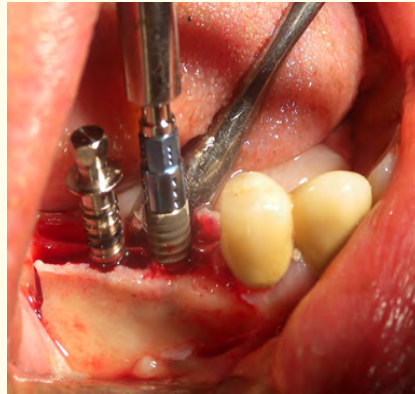


Figure 9: *Placing the first implant in place while the separation kept preserved placing the last spreader in the second implant osteotomy site.*

Cancellous Particulate Allograft (Zimmer) was placed to fill the gap between the buccal and lingual plates of bone; with adding bone buccal to the vertical distal cut. A collagen membrane was used to cover the bone graft and protect it. The flap was advanced to cover the augmented site for final tight suture primary closure (Figure 10 and 11).



Figure 10: *Final placement of the implants and the allograft bone.*

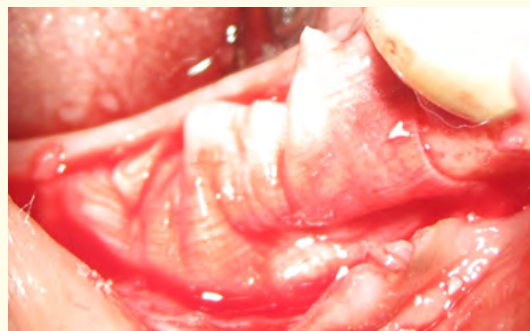


Figure 11: *Placement of resorbable membrane.*

Loading of the implants were done after 6 months with splinted implant crowns using implant-protected and group function occlusion (Figure 12 and 13). A clinical and radiographic follow up was implemented for the case up to 3 years following loading of the implants, and it showed stable implants and prosthesis (Figure 14 and 15).



Figure 12: Final prosthesis (buccal view).



Figure 13: Final prosthesis (occlusal view).

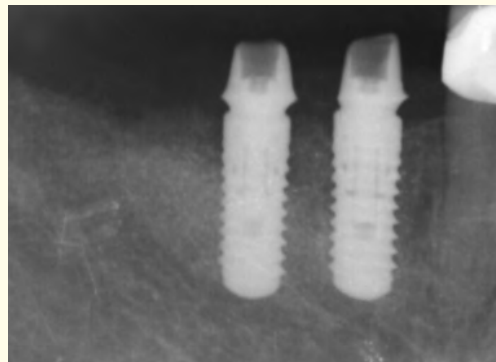


Figure 14: Periapical radiograph after fixation of the abutments and before cementation of the crowns.

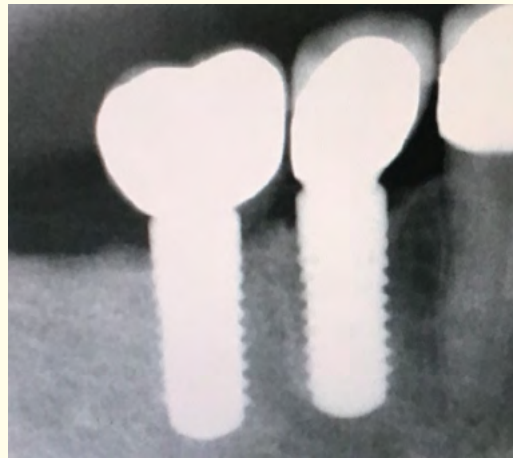


Figure 15: 3-years follow-up periapical radiograph.

Discussion

Although different techniques exist for reconstruction of atrophic ridge, there are chances of surgical risk, post-operative morbidity and multiple surgeries [2,3]. Various surgical widening techniques have been described, including lateral augmentation with [4,5] or without guided bone regeneration [6], ridge expansion osteotomy [7,8], ridge splitting technique with [9,10] or without [11] interpositional grafting and horizontal distraction osteogenesis [12].

Favorable conditions of posterior mandible for ridge splitting techniques include long edentulous span, abundant bone height and presence of cancellous bone between the dense outer cortical plates [13,14]. A staged approach to ridge splitting in the mandible can be performed to avoid complications. Another technique for placement of dental implants in narrow bone ridges is repositioning and remodeling of alveolar bone by controlled expansion [15].

Several techniques were described in relation to osteotomy design, Enislidis, *et al.* [11] have described a staged ridge splitting technique. On the contrary, González-García, *et al.* [16] believe that the staged ridge splitting technique is unnecessary.

Blus and Szmukler-Moncler [17] proposed the split-crest and immediate implant placement with ultra-sonic bone surgery, stating that by means of the green-stick fracture no additional fixation procedures such as bicortical screws were necessary for adequate implant stabilization. In the authors' opinion, the green-stick fracture provides a firm self-space-making structure that may be able to keep the bone graft following the osteotomy.

Scipioni, *et al.* [18] considered that the split-crest technique creates a self-space-making structure. In relation to the so-called 'guided bone regeneration', the use of barrier membranes has been reported to cover implants following a split-crest technique.

According to Hollinger, *et al.* [19], significant advantages of ridge expansion rather than onlay grafting include simultaneous implant placement and grafting, lower cost, lower possibility of cross-infection from graft materials and lower morbidity. This technique has greater predictability, since the grafted area is essentially a five-wall bony defect, with excellent blood supply. There must be adequate

available bone height for implant placement, and no vertical bone defect should be present. A minimum of 3 mm of bone width, including at least 1 mm of cancellous bone is desired to insert a bone chisel between cortical plates and consequently expanding the cortical bones [13].

The modification of the classical split technique presented in this clinical case presentation; provides an acceptable inter-cortical gap, avoiding the risk of fracture of the outer cortex, preserving the blood supply needed for osseointegration. This also provides a firm-tight and strong wall for the placement of particulate bone grafting together with simultaneous implant placement.

Acknowledgements

The author would like to acknowledge Dr. Ahmed Osman; Dr. Tamer Sabry; Dr. SamehDuaibis and Dr. HazemMourad.

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Volume 7 Issue 1 January 2017

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